



First record and redescription of *Helionothrips annosus* Wang, 1993 (Thysanoptera, Thripidae) in South Asian region: a pest of True Cinnamon Tree, *Cinnamomum verum* J.Presl. in Sri Lanka

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Abstract

A thrips species, *Helionothrips annosus* Wang, 1993, is reported for the first time from the South Asian region as a leaf damaging pest on True Cinnamon Tree in Sri Lanka and taxonomically redescribed. The species is very distinct in having a complete comb of microtrichia on abdominal tergite VIII. Female is dark brown and 1.5–1.6mm in length with a prominent transverse occipital ridge and metascutum triangle with posterior margin extending over the metascutellum. Its local distribution, alternative host plants, and damage to cultivated True Cinnamon leaves are also recorded in this study.

Keywords

Host plants, leaf damage, new record, Panchaetothripinae, thrips

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Introduction

True Cinnamon Tree, *Cinnamomum verum* J.Presl. (synonym: *Cinnamomum zeylanicum* Blume), is a crop extensively cultivated in Sri Lanka. The estimated extent of cinnamon cultivation was 34,777 ha in 2020, with a total export of 18,722 t of processed cinnamon (DEA 2021). The cultivation of cinnamon in Sri Lanka is being expanded to cater to the increasingly high demand for

exports. We use “cinnamon” hereafter to refer to the True Cinnamon Tree.

A new pest damage on cinnamon was recorded in Sri Lanka by 2015. Farmers and nursery managers complained about an emerging trend of tender leaves being attacked and curled. When infested, each new flush, as well as immature leaves, were scraped and became

scorched. Dark fecal droplets are prominent on leaves under attack. Leaves become distorted and sometimes entirely dry. Occasional shedding and death of the apical buds are observed and rosetting of leaves is also noticeable (DEA 2015). When the attack is severe, complete death of the branch or the whole plant is possible. Under nursery conditions, this pest attack can substantially degrade the quality of cinnamon plants, causing high mortality in immature plants. These symptoms and preliminary microscopic studies revealed that this damage was caused by a species of thrips (Insecta, Thysanoptera).

The Thysanoptera comprises 6377 extant species in 785 genera (Thrips Wiki 2022). They are widespread around the world but with a preponderance of tropical species, followed by temperate ones, and a few in arctic regions (Lewis 1973). Many of the thrips are plant feeders breeding on flowers, leaves, fruits, twigs, or buds (Borror et al. 1989). In some cultivated plants, thrips cause feeding damage, including silverying, scarring, leaf curling and deforming, loss of premature flowers, leaf colour damage, gall induction, and die-back of leaf tips (Mound and Kibby 1998). Some species of thrips are vectors of plant diseases (Triplehorn and Johnson 2006), while their direct effect includes contamination of packaged food items. Some species of thrips have beneficial roles in agriculture as predators (Tillekaratne et al. 2011).

Tillekaratne et al. (2011) conducted an extensive island-wide survey in 2005–2008 in which they inspected over 1000 plant species in 22 study sites in Sri Lanka. They recorded 72 species of thrips belonging to 45 genera in five subfamilies (Tillekaratne et al. 2011). According to that checklist, three thrips species have been recorded in different *Cinnamomum* spp. in Sri Lanka, but only two species have been taxonomically identified: *Liothrips floridensis* Watson, 1913 from *C. camphora* (L.) J.Presl., and *Thrips subnudula* Karny, 1926 from *C. verum*.

Our objective is to taxonomically confirm the identity of the Cinnamon Thrips, *Helionothrips annosus* Wang, 1993, from areas of major cinnamon cultivation in Sri Lanka and to explore its current spread and describe its damage on True Cinnamon and alternative host plants.

Methods

We sampled cinnamon thrips from major areas of cinnamon cultivation in four administrative districts of Sri Lanka: Matara, Galle, Hambantota, and Kegalle (Fig. 1). Mature cinnamon plantations and nurseries were searched for the presence of thrips. Specimens were collected from the young leaves or flush of *C. velum* plants. We collected thrips manually, transferring them using a fine brush as described by Mound and Kibby (1998) to a vial containing 80% ethyl alcohol for temporary preservation. We also recorded the presence of the thrips on cultivated cinnamon in other administrative districts of the country, their alternative host plants, and their

damage.

Samples of preserved thrips were sorted under a stereomicroscope model Zeiss Stemi 508 and identified at the Insect taxonomy Laboratory of the Institute of Weed Science Entomology and Pathology, University of Philippines Los Banos, Philippines, and the Plant Protection Laboratory, National Cinnamon Research and Training Centre (NCRTC), Department of Export Agriculture, Thihagoda, Sri Lanka. Voucher specimens are deposited in the NCRTC.

Some specimens that mounted onto microscope slides were macerated in 2% NaOH solution overnight to remove the body contents to make it easier to study surface details, as described by Mound and Kibby (1998). The remaining specimens were either mounted without maceration to preserve the natural color patterns or macerated by boiling in 2% NaOH.

Both permanent Canada balsam mounts and Hoyer's medium mounts were used. Identifications were made using keys provided by Palmer et al. (1992) and Mirab-balou et al. (2017). Photographs were taken using a ZEISS Stemi 508 microscope.

Confirmation of the taxonomic identification was made by one of us (M.R. Ulitzka).

Results

Helionothrips annosus Wang, 1993

Figure 3

Material examined. SRI LANKA – **Southern province** • Matara district, Karagoda Uyangoda; 06.0600°N, 080.5300°E; 16 m alt.; 14.xii.2019; C.U. Widanapathirana leg.; on *C. zeylanicum*; 4♀, 2♂, CT01 • Matara district, Palolpitiya; 06.0283°N, 080.5593°E; 15 m alt.; 13.viii.2020; H.M.T.T. Madhurangi leg.; on *C. zeylanicum*; 10♀, 2♂, CT02 • Matara district, Morawaka; 06.2630°N, 080.4821°E; 131 m alt.; 19.xii.2019; S.A. Yap leg.; on *C. zeylanicum*; 5♀, 3♂, CT03 • Mataradistrict, Thihagoda; 06.0278°N, 080.5601°E; 15 m alt.; 13.viii.2020; C. Maddegoda leg.; on *C. zeylanicum*; 7♀, 3♂, CT04 • Hambantota district, Beliatta; 06.0247°N, 080.7026°E; 84 m alt.; 15.viii.2020; C.U. Widanapathirana leg.; on *C. zeylanicum*; 8♀, 2♂, CT05 • Hambantota district, Weeraketiya; 06.1444°N, 080.7414°E; 16.viii.2020; 66 m alt.; C.U. Widanapathirana leg.; on *C. zeylanicum*; 2♀, 5♂, CT06 • Hambantota district, Sooriyawewa; 06.2555°N, 080.9702°E; 46 m alt.; 16.viii.2020; C.U. Widanapathirana leg.; on *C. zeylanicum*; 2♀, 5♂, CT07 • Galle district, Batapola; 06.2220°N, 080.1161°E; 19 m alt.; 18.viii.2020; C.U. Widanapathirana leg.; on *C. zeylanicum*; 12♀, 3♂, CT08 – **Sabaragamuwa province** • Kegalle district, Warakapola; 07.1580°N, 080.1887°E; 146 m alt.; 20.viii.2020; C.U. Widanapathirana leg.; on *C. zeylanicum*; 15♀, 3♂, CT09.

Identification. Female 1.5–1.6 mm long on slide, dark brown; abdominal segments VIII–X pale; forewing base wide and dark brown with microtrichia. Wing base

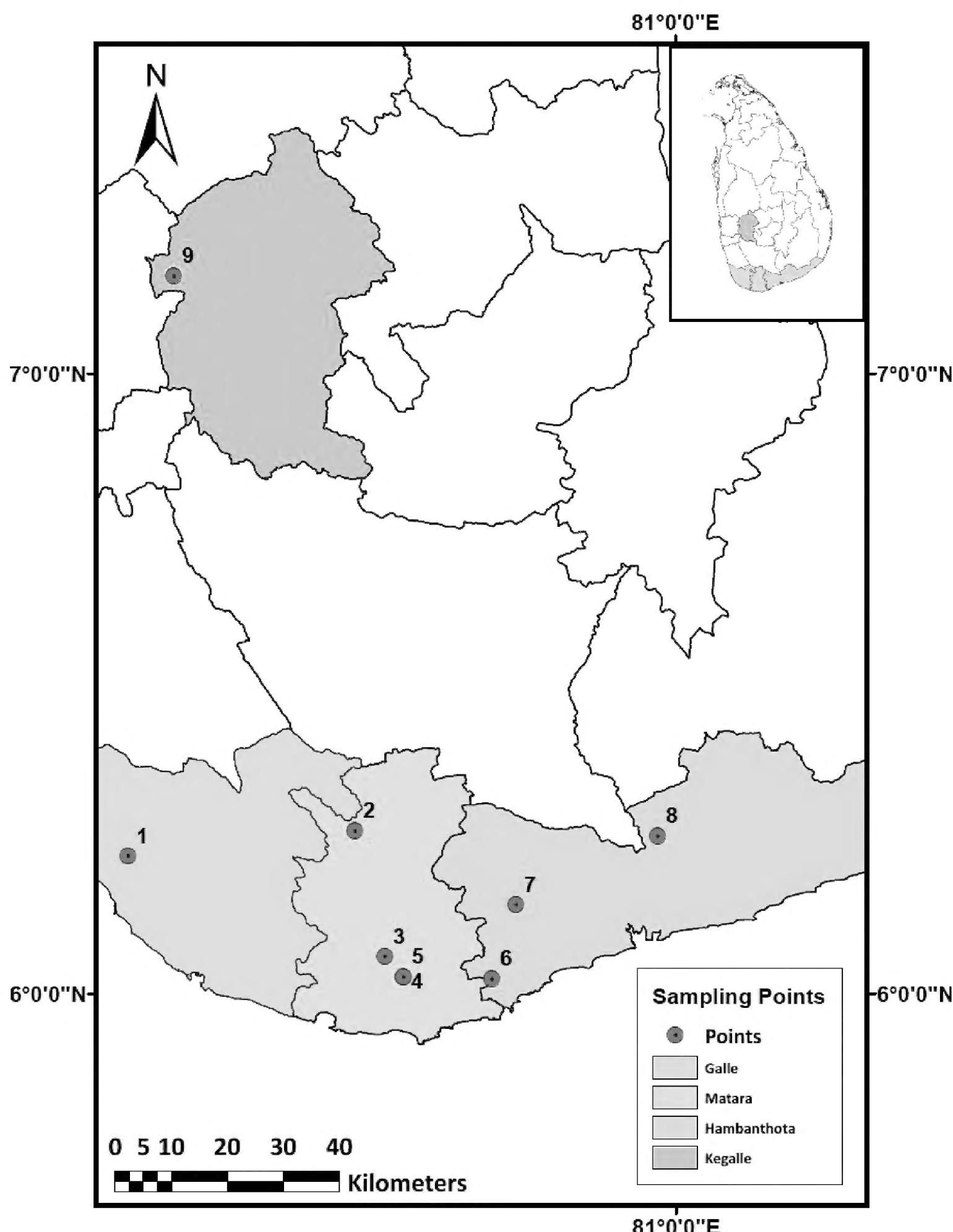


Figure 1. Map of Sri Lanka. Areas where True Cinnamon (*Cinnamomum verum*) is cultivated in large scale in four administrative districts of Sri Lanka and where *Helionothrips annosus* were sampled. 1 = Batapola (Galle district), 2 = Morawaka (Matara district), 3 = Karagoda Uyan-goda (Matara district), 4 = Thihagoda (Matara district), 5 = Palolpitiya (Matara district), 6 = Beliatta (Hambantota district), 7 = Weeraketiya (Hambantota district), 8 = Sooriyawewa (Hambantota district), 9 = Warakapola (Kegalle district).

with three dark bands and one transparent band; rest of the wing yellowish brown; wing apex slightly darker and pointed. Cilia at the front of fore wing shorter and straight; cilia at back longer and wavy. Fore femora darker than tibia, with distal third yellowish. Fore tibia yellow. Mid and hind femora and tibiae brown. Tarsi yellow, with one tarsomer (Fig. 4A). Femora and tibia polygonally reticulate. Head wider than long, slightly concave behind compound eyes; dorsal area between compound eyes polygonally reticulate; anterior margin of collar almost parallel to posterior margin; reticulations on collar with minute black granules; thick transverse occipital ridge present behind compound eyes. Prothorax broad

and pronotum polygonally reticulate (Fig. 4B). Antennae starts at front of head between compound eyes and immediately before compound eyes; antennae more than 8-segmented; segments III and IV with forked sense cones. Sense cones of segment IV reaching middle of VI; IV–VI with microtrichia (Fig. 4C). Setae minute; major setae of body pale brown. Mesonotum and metanotal triangle polygonally reticulate. Abdominal tergite VIII with complete comb on posterior margin (Fig. 4D). Metascutum triangle with posterior margin extending over metascutellum (Fig. 4F). Abdominal tergites reticulated but with longer polygons; tergite ix with two pairs of major setae along posterior margin (Fig. 4E).

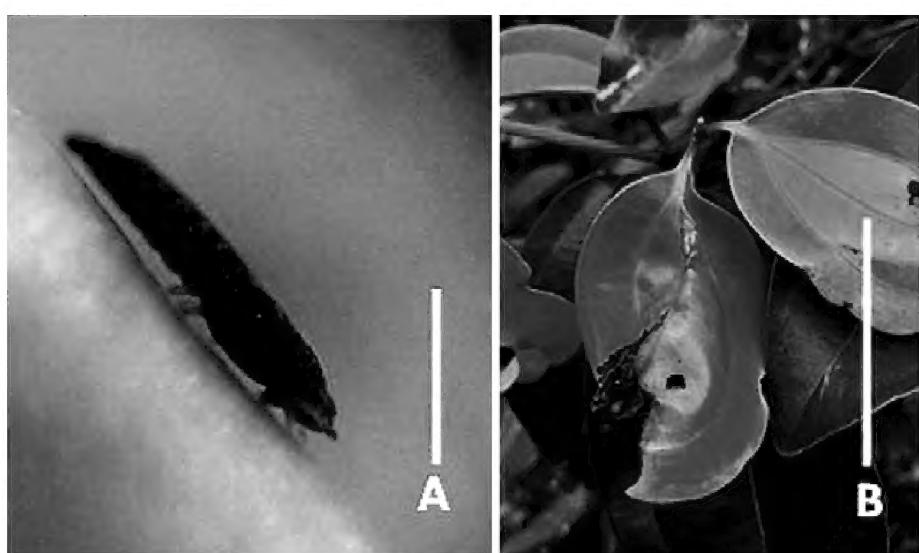


Figure 2. *Helionothrips annosus*. **A.** Female. **B.** General feeding damage to tender *Cinnamomum verum* leaves. Scale bars: A = 750 μ m, B = 6 cm.



Figure 3. *Helionothrips annosus*. Scale bar: 750 μ m.

Ovipositor serrated and well developed, located ventrally on IX (Fig. 4G).

Male: 1.4–1.5 mm long; color and shape similar to female. Abdomen more slender than in female, body more pointed, and anterolateral margin of VIII and IX not as prominently swollen. Tergite IX with two pairs of spinula arranged in two rows; anterior pair slightly longer than posterior pair and followed by several dark warts.

In *H. annosus* and *H. errans* Williams, 1916 the abdominal tergite VIII has a complete comb on the posterior margin (Fig. 4D), but only *H. annosus* has the metasutum triangle with a posterior margin extending over the metascutellum (Fig. 4F) and a male without pore plates on abdominal sternites. *Helionothrips brunneipennis* Bagnall, 1915 is the only other species of *Helionothrips* recorded in Sri Lanka, and it is clearly distinct from *H. annosus*, as its comb on the posterior margin of abdominal tergite VIII is medially interrupted and both antennomeres I and II are brown. In *H. brunneipennis*, antennomere IV is as dark as antennomere II and the forked sensory cone on antennomere IV reaches the apex of antennomere VI. The male has pore plates on

abdominal sternite VIII.

Distribution. *Helionothrips annosus* occurs on *C. verum* in all areas of cinnamon cultivation in 14 administrative districts of Sri Lanka (Fig. 5). The populations were evidently dependent on the availability of tender leaves on the crop, which coincides with the harvest as well as rainfall.

Alternate host plants. Several wild relatives of *Cinnamomum verum* also occur in Sri Lanka, namely *C. sinharajaense* Kosterm, *C. dubium* Nees, *C. ovalifolium* Weight, *C. listeqolium* Thw, *C. citriodorum* Thw., *C. capparu coronde* Blume and *C. rivulorum* Kosterm (DEA 2015). *Helionothrips annosus* was observed infesting on *C. dubium* and *C. capparu coronde*, with similar symptoms as on *C. ceylanicum* (Fig. 6). *Helionothrips annosus* was not recorded on any of the common weed species associated with cinnamon plantations, and *Alseodaphne semecarpifolia* Nees, *Neolitsea cassia* (L.) Kosterm, *N. fuscata* (Thwaites) Alston, or *Persea americana* Mill, which are commonly associated with cinnamon and also belong to the family Lauraceae as of cinnamon also were not observed to host *H. annosus*.

Damage to cinnamon. The initial damage is a slight change in color, commonly at the immature leaf tip, as a result of the laceration of the leaf by the larval stages of the *H. annosus*. Five immature stages can be commonly observed in thrips-infested cultivated cinnamon (Fig. 9). Under the microscope, this damage appears like water-soaked patches. After 24 h, these patches become brown and the excretion by the thrips, appearing as shiny droplets, is present on the underside of the leaf tip (Fig. 7A). The damage then expands and the leaf tip starts to distort. Within a week, depending on the severity of the infestation, the distal part of the immature leaf can be completely curled and dark brown. If the initial damage is to a smaller leaf, the entire leaf blade can become completely desiccated and detach from the stalk (Fig. 8). When *H. annosus* infestation occurs on cultivated cinnamon plants, drying of the apical buds and complete death of the plant is possible. Some plants may show the rosette formation in leaves (Fig. 7B).

Discussion

Helionothrips annosus, is one of 28 species of *Helionothrips* Bagnall, 1932, which is one of the most species-rich genera in the subfamily Panthaetothripinae. This genus is the largest among the 40 extant genera in this subfamily (Johnson et al. 2019). Almost all *Helionothrips* species have been recorded from Asian tropics (Sartiami and Mound 2013). Thirteen species have been recorded from China, where the genus has a wide geographical range from southwestern through southern to eastern part of the country. *Helionothrips* species are leaf feeders, and one species that has been reported to be of economic significance is *H. kadaliphilus* (Ramakrishna & Margabandhu, 1931), which is an

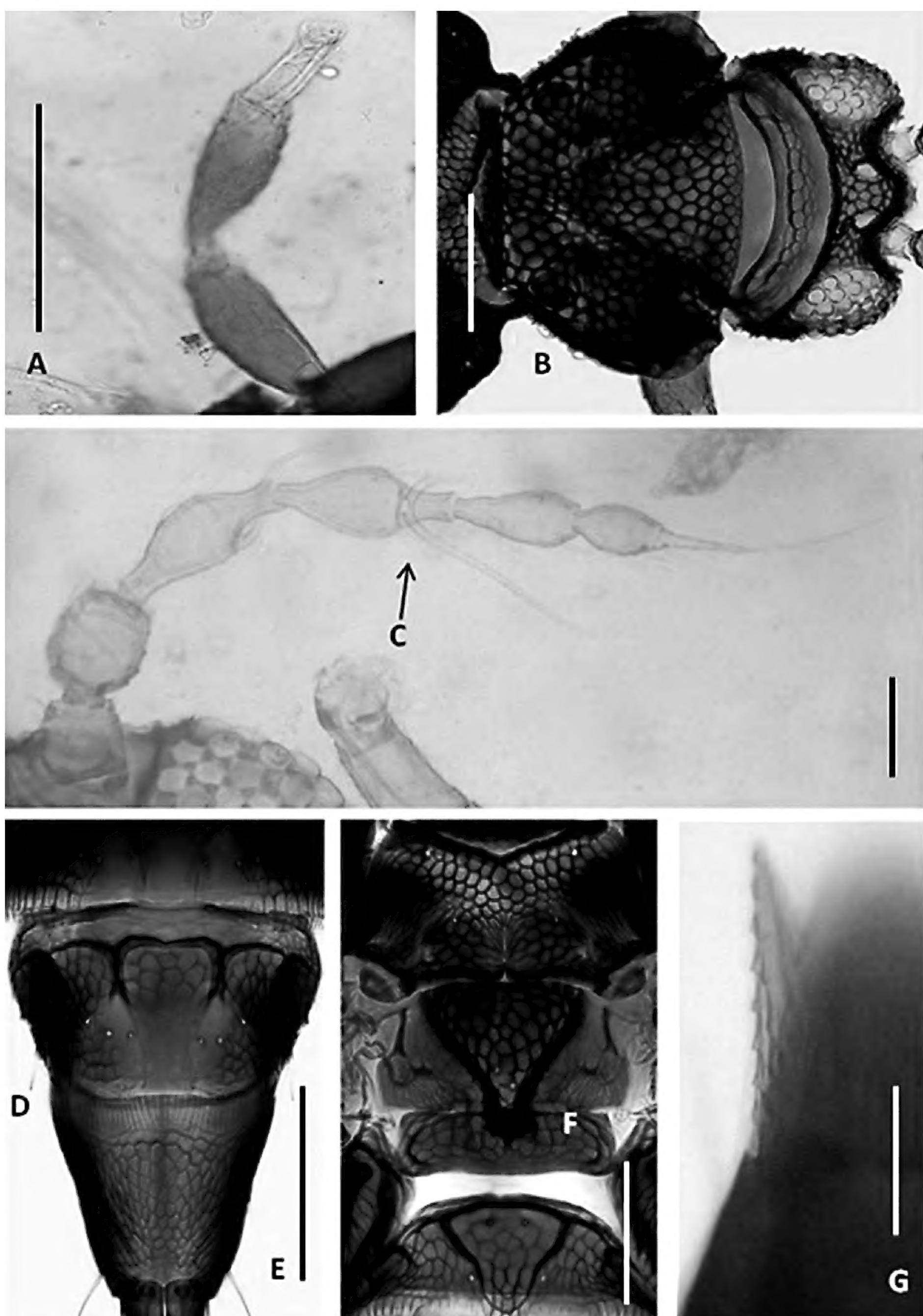


Figure 4. Head, thorax, and abdomen of *Helionothrips annosus*. **A.** Foreleg. **B.** Prothorax. **C.** Forked sense cones of antennae. **D.** Complete comb on posterior margin of abdominal tergite VIII. **E.** Abdominal tergite IX with two pairs of major setae along posterior margin. **F.** Metascutum triangle with posterior margin extending over metascutellum. **G.** Ovipositor. Scale bars: A = 120 μ m; B = 6 μ m; C = 20 μ m; D; E, F = 8 μ m; G = 5 μ m.

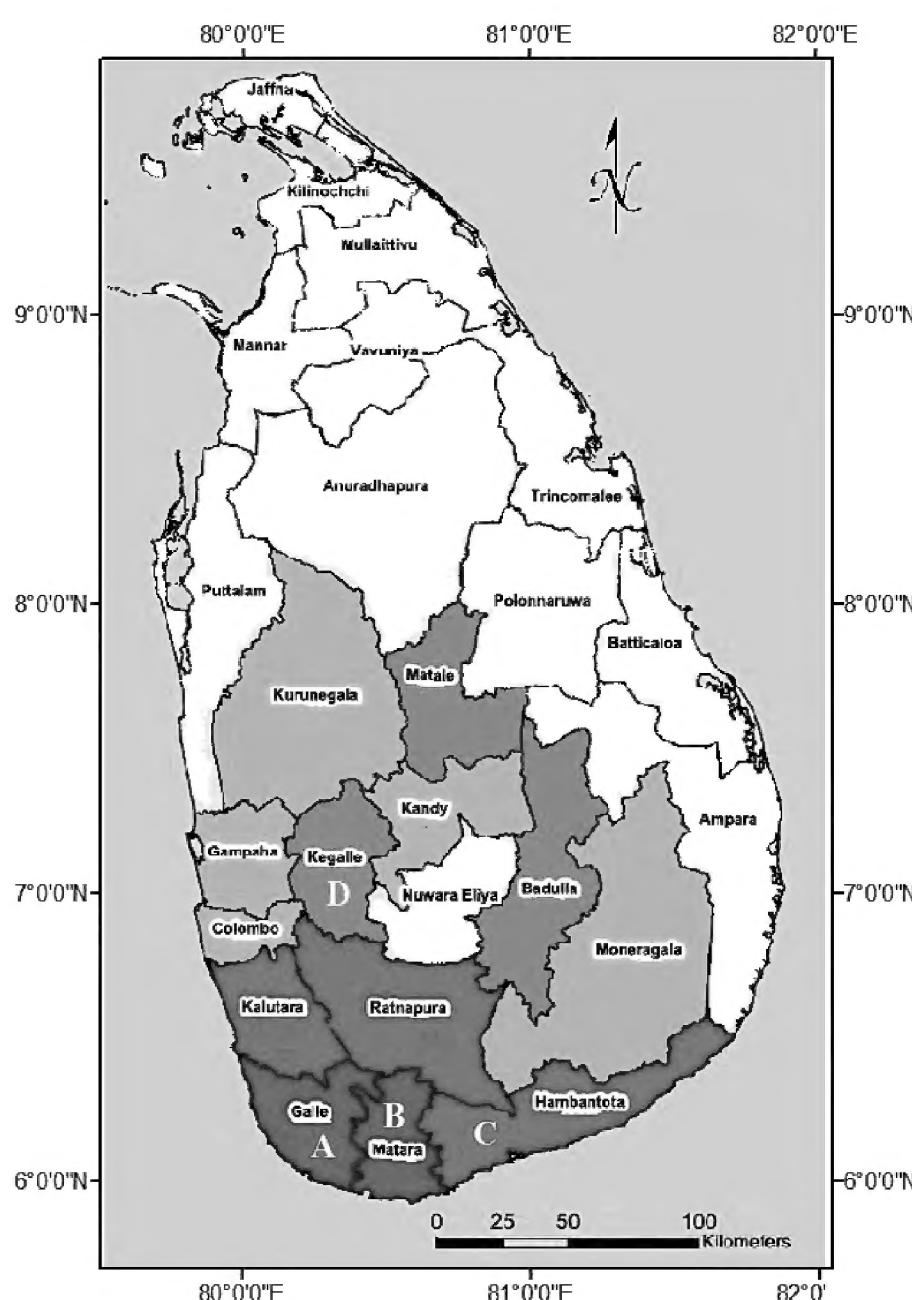


Figure 5. Known distribution of *Helionothrips annosus* in Sri Lanka where cinnamon is commercially cultivated (darker colored areas). We sampled *H. annosus* from those administrative districts labelled A–D.



Figure 6. Alternate host plants of *Helionothrips annosus*. **A.** *Cinnamomum dubium*. **B.** *C. capparu coronde*. Scale bars: A = 7 cm, B = 45 mm.

occasional pest on banana (*Musa* sp.) (Mirab-balou et al. 2017).

Helionothrips annosus was well described by Wang (2016). It is widely distributed in southern China and is mainly associated with older leaves of Lauraceae, for example, *C. camphora* and *C. burmannii* (Nees & T.Nees) Blume (Mirab-balou et al. 2017) and it has been found on *Litsea* sp. in Taiwan (Mirab-balou et al. 2011; Wang 2016). It has been recorded from the Peninsular Malaysia (Mound and Azidah 2009). According to Johnson et al. (2019), *H. annosus* has not yet been recorded from India, and Rachana and Varatharajan (2017) mention only five *Helionothrips* species in India: *H. aino* Ishida, 1931, *H.*

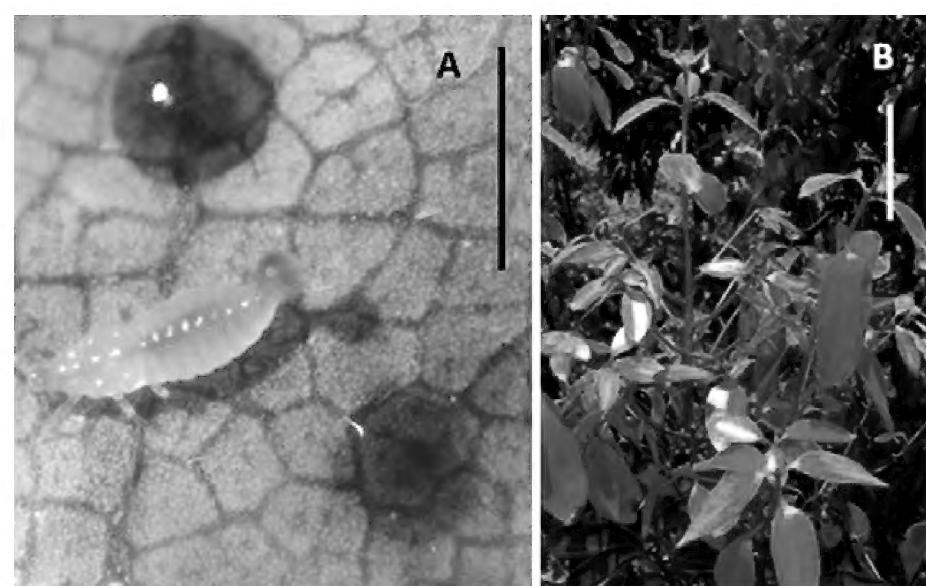


Figure 7. Symptoms of *Helionothrips annosus* on *Cinnamomum verum*. **A.** Excretion on a leaf. **B.** Rosette formation. Scale bars: A = 3 mm; B = 40 mm.

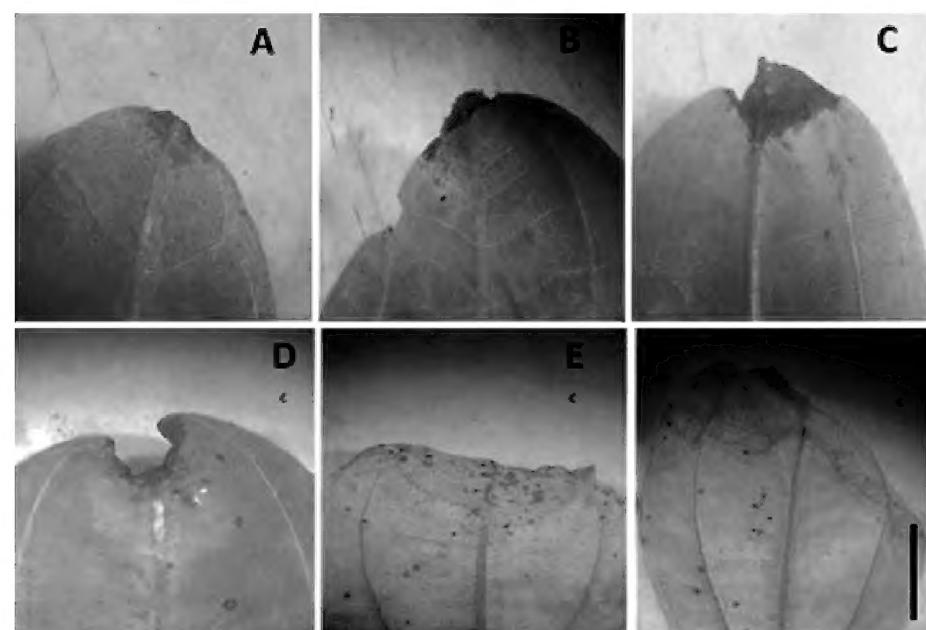


Figure 8. Leaf damage of *Helionothrips annosus*, showing the gradual development of the infestation on a leaf of *Cinnamomum verum* in a nursery. Scale bar: 1 cm.

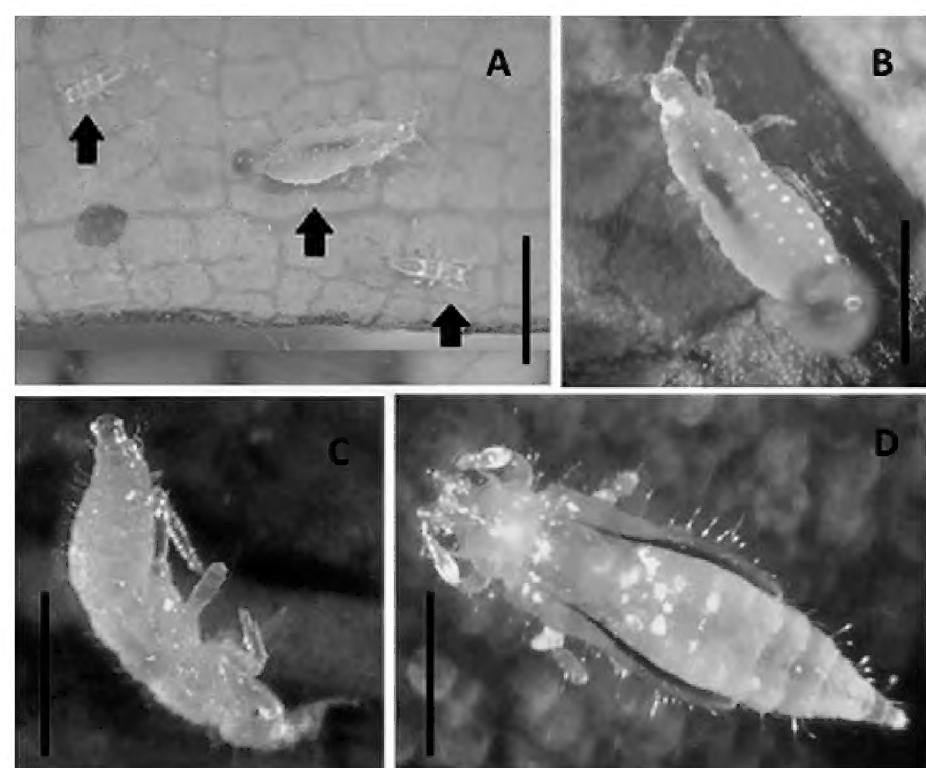


Figure 9. Immature stages of *Helionothrips annosus* on *Cinnamomum verum*. Scale bars: A = 3 mm; B = 3 mm; C = 2 mm; D = 2 mm.

kadaliphilus, *H. nilgiricus* Ananthakrishnan, 1967, *H. parvus* Bhatti, 1968, and *H. shivalik* Bhatti Rachana & Varatharajan, 2017. In a survey conducted in Pakistan from 2009–2012, Iftikhar et al (2016) found 42 species of thrips in 20 genera, but *H. annosus* was not found.

Helionothrips annosus has been recorded in the

Philippines, where *H. guttatus* Reyes, 1994 also occurs. *Helionothrips annosus* is very distinct in having a complete comb of microtrichia on T8 and slender abdominal segments IX and X. Philippine *H. guttatus* mostly agrees with *H. annosus* in having these characters, but in the description of *H. guttatus* by Iwao (1995), the male has a transversely elongate glandular area on each of S3 to S8.

In our study, we report *H. annosus* from Sri Lanka for the first time. This is an economically important leaf-damaging pest in cultivated cinnamon, a highly valued plantation crop in Sri Lanka. As *H. annosus* has been previously recorded from Taiwan, Malaysia, China, and the Philippines, and as there are no previous records from the South Asian region, our new data represent the first records of this species from the South Asian region.

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Authors' Contributions

Conceptualization: GGJ. Formal analysis: CUW. Investigation: CUW. Methodology: CUW. Project administration: GGJ. Resources: GGJ. Supervision: SAY. Validation: MRU. Visualization: CUW, MRU. Writing – original draft: CUW. Writing – review and editing: SAY.

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